CARBOLITE®
a VERDER company



HEAT TREATMENT TO 3000 °C

SOLID FUEL & IRON ORE TESTING FURNACES



HEAT TREATMENT | ELEMENTAL ANALYSIS | MATERIALOGRAPHY & HARDNESS TESTING
MILLING & SIEVING | PARTICLE CHARACTERIZATION | PHARMACEUTICAL TESTING

WE ENABLE PROGRESS FOR THE BENEFIT OF MANY

VERDER SCIENTIFIC is composed of leading laboratory equipment companies active in sample preparation and analysis for quality control as well as research & development purposes. As trusted solution partner, VERDER SCIENTIFIC enables thousands of companies to ensure economic, technological and environmental progress by mastering their scientific applications. Together, we make the world a healthier, safer and more sustainable place.

ENABLING PROGRESS www.verder.com

HEAT TREATMENT TO 3000 °C

CARBOLITE – OVER 85 YEARS OF INNOVATION

The Carbolite brand is synonymous with high quality, leading heat technology in the design and manufacture of laboratory and industrial ovens & furnaces ranging from 30 °C to 3000 °C which are sold globally to over 100 countries.

In 2016 Carbolite (UK) and Gero (Germany) merged to become one company under the name of Carbolite Gero. With the combined product lines, the company has strengthened its market position locally and globally. In 2025 the company rebranded to Carbolite.

Carbolite has two manufacturing and sales sites. One is based in Derbyshire in the United Kingdom, where Carbolite manufactures laboratory and industrial ovens and furnaces up to 1800 °C; the second facility is located in Neuhausen, southern Germany, where high temperature furnaces up to 3000 °C with a large variety of solutions for vacuum and other modified atmospheres have been manufactured since 1982.

In addition to the extensive range of standard products as shown in this catalogue, Carbolite is an expert in the development of customized equipment for complex heat treatment processes. Solving customers' individual application requirements has given Carbolite an important place in aerospace, engineering, materials science, heat treatment, medical, bioscience and contract testing laboratories globally. Not only can Carbolite supply products with Standards-compliant furnace and oven designs (e.g., Nadcap heat treatment processes (AMS2750H)), but also fully traceable certification for control, measurement, recording and data acquisition devices, issued by an independent UKAS accredited laboratory.

All products, and more, featured in this catalogue are available through your local Carbolite office, Verder Scientific office or an extensive network of third-party dealers and sales organisations.

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Carbolite, Neuhausen/Germany



Carbolite, Hope/United Kingdom

1938
Carbolite founded in Sheffield

1966
Production moves from Sheffield to Bamford Mill

1982
Gero founded in Germany

1993
Carbolite relocates to a new site in Hope as Gero relocates to Neuhausen

2012/13
Carbolite and Gero acquired by Verder Group

2016
Companies merged as Carbolite Gero

2025
Carbolite Gero rebranded to Carbolite

Carbolite launches its own temperature controller AriesPlus

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DISCLAIMER

As Carbolite has a policy of continuous product development, improvements and changes will be made during the lifetime of this catalogue. Carbolite reserves the right to amend the specifications at any time and in any particular way without prior notice provided that the ultimate performance of the equipment is not reduced by such action. If the dimensions or technical specification of a product in this catalogue are critical, it is important that Carbolite is contacted to confirm the details prior to order placement.

ICONS USED IN THIS CATALOGUE

Icons are displayed against products that feature these details

Qualitatively assesses.
Test method is empirical.

Quantitatively measures.
Test method is used to provide a measurement or value.

Moisture determination quantifies the amount of moisture in the material.

The content of a material that is liberated at high temperature in the absence of air (not including moisture).

Ashing removes all the content of the sample material that can be burnt in air, leaving behind non-combustible material.

3 ZONE — Product incorporates zoned temperature control. The number represents the number of heated zones.

Product incorporates rotary motion. Example: tumbler for CSR (coke strength after reduction).

CGH — Manufactured at Carbolite Hope

CGN — Manufactured at Carbolite Neuhausen

CARBOLITE'S EXPERTISE IN COAL, COKE AND IRON ORE TESTING, BIOMASS & SOLID RECOVERED FUELS

The characterisation of coal is important for its quality assessment. The most common types of coal (lignite, bituminous and anthracite) can be distinguished by their different chemical and physical properties. Depending on the product quality, coal is suitable for a variety of uses including coking, steel production and power generation.

The formation of coal from a variety of plant materials via biochemical and geochemical processes is called coalification. The nature of the constituents in coal is related to the degree of coalification, the measurement of which is termed rank. Rank is usually assessed by a series of tests, collectively called proximate analysis, that determine the moisture content, volatile matter content, ash content, fixed-carbon content, and calorific value.

Carbolite has developed a range of coal and coke testing furnaces and ovens for proximate analysis to qualitatively assess or, quantitatively measure, the amount of moisture, ash, volatile matter and fixed carbon in coal samples. Other products are also available for the determination of coke reactivity, iron ore reducibility, ash fusibility, swelling number index, expansion and contraction of coal and caking properties.

The range of coal and coke tests carried out in a furnace or oven has grown over many years, and Carbolite has responded to the requirements of each new standard by designing a product to suit the specific requirements of each test method.

The range includes bench top laboratory models for routine testing and large pilot plant scale products, some of which are unique to Carbolite, such as the variable width hearth moving wall coking oven which can be found in coal research facilities as well as large steel producing plants around the world.

Retsch GmbH, within the Verder Scientific group, offers a range of products for sample prepartion of all types of coal whilst Retsch Technology products are suitable for the characterization of coal-related products. Find out more online www.retsch.com.

Also within the Verder Scientific Group, Eltra GmbH offers a range of equipment for elemental analysis. Find out more online www.eltra.com.

Carbolite operates a stringent quality management system and is ISO 9001 accredited. All products carry the CE mark indicating compliance with all relevant European safety directives, ie, machinery directive, low voltage directive and electromagnetic compatibility directive.

The Carbolite range of products meets the requirements of the relevant international ISO, ASTM, EN, BS, and DIN test methods.

For further information on all Carbolite coal and coke products enquire at info@carbolite.com.

PILOT PLANT SCALE COAL & COKE TEST FURNACES

- CRI - Coke Reactivity Furnace
- CSR - Coke Strength after Reduction Furnace
- CTO 7 - Fixed Wall Coke Test Oven
- IOR - Iron Ore Reducibility Furnace
- GLO - Coal Characterisation Furnace
- LTD - Low Temperature Reduction Furnace

DISCOVER OUR SOLUTIONS



MFS/1 – MINIMUM FREE SPACE OVEN

From its natural development to its processing, coal contains an amount of moisture which needs to be quantified.

One method of quantifying moisture in coal is by measuring the weight loss of a sample after drying. The MFS is used for this drying process and has a small heated chamber to provide the lowest practical volume, ie, minimum free space, as required by the test standards. A known mass of the coal is heated in a stream of nitrogen or air at a temperature between 105°C and 110°C and maintained at this temperature until its mass is constant. The moisture content is calculated from the loss in mass of the coal.

The ovens have a corrosion and oxidisation resistant aluminium chamber which provides good temperature uniformity. The nitrogen or air flow can be adjusted by a flow meter fitted on the control panel and passes through a pre-heating chamber before entering the front of the work chamber.

The MFS/1 ISO operates with a regulated flow of moisture- free bottled nitrogen which removes the moisture released by the coal at 105 °C. The MFS/1 ASTM operates with a regulated flow of air.



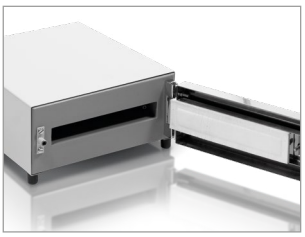
MFS/1

STANDARD FEATURES

- 210 °C maximum operating temperature
- 132 controller fitted as standard
- Loading tray
- Flow meters to monitor gas flow & chamber seal integrity

OPTIONS (SPECIFY THESE AT TIME OF ORDER)

- Welded steel desiccator with provision for a nitrogen flow which is used as a cooling vessel. The crucibles can be transferred directly into the desiccator without the need for cooling on a metal plate.
- Models available for alternative mains supply voltages
- Over-temperature control
- Crucibles with well-fitting covers



Optional desiccator



Aluminium loading tray showing optional crucibles with well-fitting covers. The maximum number of crucibles per tray is 15.

Standard	Description	Suitable oven	
BS ISO 687:2024	Solid mineral fuels - Coke - Determination of moisture in the general analysis test sample	MFS/1 ISO	–
BS ISO 11722:2013	Solid mineral fuels - Hard coal - Determination of moisture in the general analysis test sample by drying in nitrogen	MFS/1 ISO	–
ASTM D3173-25	Standard Test Method for Moisture in the Analysis Sample of Coal and Coke	–	MFS/1 ASTM

OPTIONS PART NUMBERS

Option	Item number
Desiccator for MFS	MFS DESICCATOR
Silica crucibles	40-209-460-0050
Aluminium crucible lids	40-209-100-0010
Crucible kit (crucible and lid)	MFS-CRUC-KIT
Additional trays	00047-4-1532-SP

TECHNICAL DATA

CGH Model	Meter type	Max. operating temp. [°C]	Chamber dimensions H x W x D [mm]	External dimensions H x W x D [mm]	**Temperature uniformity [°C @ 210 °C]	Temperature stability [°C]	Volume [litres]	Max. power [W]
MFS/1 ISO	Nitrogen	210	25* x 195 x 290	185 x 490 x 450	±0.5	±0.5	1.4	500
MFS/1 ASTM	Air	210	25* x 195 x 290	185 x 490 x 450	±0.5	±0.5	1.4	500

* reduced to 22 mm below the thermocouple
** uniformity is measured in an empty chamber after a stabilisation period



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VMF – VOLATILE MATTER FURNACES

Volatile matter in coal, ie, the matter given off before oxidisation, refers to the volatile components of coal, except moisture, which are removed at high temperature in the absence of air. This is usually a mixture of short and long chain hydrocarbons, aromatic hydrocarbons and some sulphur.

Volatile matter is determined as the loss in mass, less that due to moisture, when coal or coke is heated out of contact with air under standardised conditions. The test is empirical and, in order to ensure reproducible results, it is essential that the rate of heating, the final temperature and the overall duration of the test be carefully controlled. It is also essential to exclude air from the coal or coke during heating to prevent oxidisation.

The fit of the crucible lid is, therefore, critical. The moisture content of the sample must be determined at the same time as the volatile matter so that the appropriate correction can be made.

The Carbolite VMF furnaces are specifically designed for testing the volatile matter of coal and meet the test methods of International Standards:

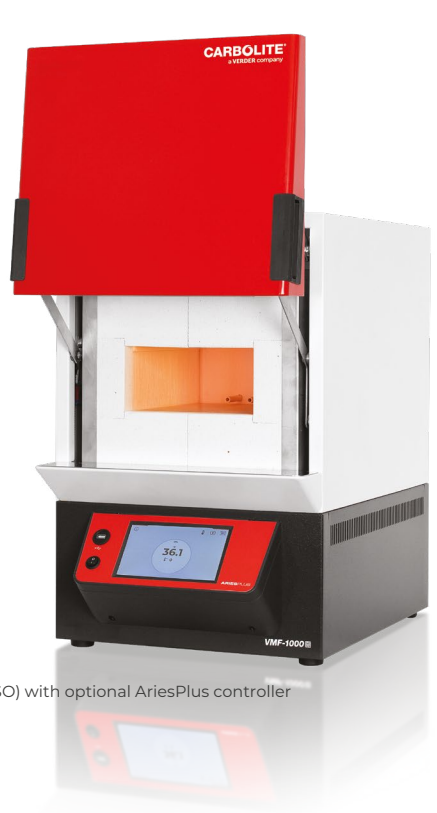
Furnace	Standard	Description
VMF 10/6	BS ISO 562:2010	Hard coal and coke – determination of volatile matter
VMF/ASTM	ASTM D3175-20	Standard test method for volatile matter in the analysis sample of coal and coke

VMF 10/6 (BS ISO 562:2024 & BS EN ISO 22167:2021) – 'HARD COAL AND COKE – DETERMINATION OF VOLATILE MATTER'

This test method determines the volatile matter of hard coal and of coke. It is not applicable to brown coals and lignites. A portion of the sample is heated out of contact with air at 900 °C for 7 minutes. The percentage mass fraction of volatile matter is calculated from the loss in mass of the test portion after deducting the loss in mass due to moisture. The VMF 10/6 offers temperature and response times to meet the requirements of BS ISO 562:2024.

STANDARD FEATURES

- 1000 °C maximum operating temperature
- 3016P1 controller fitted as standard
- Fast heating - typically 20 mins to 900 °C. Open spiral elements located in the chamber roof and under the hearth supported in low thermal mass insulation ensure the rapid heating required by the Standard
- Fast recovery of temperature after loading samples – less than 4 mins to return to 900 °C
- ± 5 °C
- Chimney at back of the chamber
- Hardwearing refractory bricks in chamber entrance for resistance to abrasion
- Calibration ports allow insertion of unsheathed probe thermocouples from the back of the chamber as required by the standard
- Suits crucibles measuring 21 mm id / 25 mm od x 38 mm high and close fitting lid



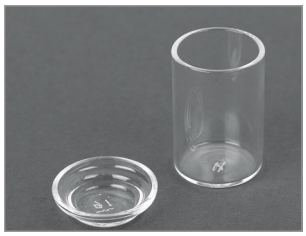
VMF 10/6 (ISO) with optional AriesPlus controller

OPTIONS (SPECIFY THESE AT TIME OF ORDER)

- 4 or 9 crucible stand
- Loading handle
- Crucibles and lids
- Controller - AriesPlus
- Digital communications or paperless nanodac recorder for documentary evidence of test procedure
- Over-temperature control

OPTIONS PART NUMBERS

Option	Item number
Crucible & lid	40-209-460-0025
4 crucible stand	00037-3-2003
9 crucible stand	00037-3-2004
Crucible stand handle	00125-3-1007



Optional Crucible with lid (VMF 10/6)



Optional 4 crucible stand + 4 crucibles with lids (VMF 10/6)

VMF / ASTM (ASTM D3175-20) – 'STANDARD TEST METHOD FOR VOLATILE MATTER IN THE ANALYSIS SAMPLE OF COAL AND COKE'

This test method determines the percentage of gaseous products, exclusive of moisture vapour, in the analysis sample which are released under the specific conditions of the test. As the test is empirical strict adherence to basic principles and permissable procedures is required to obtain valid results.



VMF / ASTM

STANDARD FEATURES

- 1000 °C maximum operating temperature
- 132 controller fitted as standard
- Top loading 50 mm diameter x 100 mm deep with hinged lid
- Corrosion and oxidisation resistant Inconel crucible & lid
- Crucible holder included as standard
- 30 mA (RCD) residual current device, for additional protection

OPTIONS (SPECIFY THESE AT TIME OF ORDER)

- Over-temperature protection

OPTIONS PART NUMBERS

Option	Item number
Inconel crucible & lid (VMF/ASTM)	40-209-010-0020
Wire crucible holder (VFM/ASTM)	00329-3-2001



Corrosion and oxidisation resistant Inconel crucible & lid (VMF/ASTM)



Standard wire crucible holder shown with crucible & lid (VFM/ASTM)

TECHNICAL DATA

CGH Model	Max. operating temp. [°C]	Continuous operating temp. [°C]	Heat-up time to 900 °C [mins]	Internal dimensions H x W x D / Ø x D [mm]	External dimensions H x W x D [mm]	Number of samples	Thermocouple type	Max. power [W]	Weight [kg]
VMF 10/6 (ISO)	1000	950	20	100 x 210 x 260	655 x 435 x 260	1, 4 or 9	K	3000	47
VMF/ASTM	1000	1000	20	50 x 100	330 x 410 x 300	1	N	950	9

AAF – COAL & BIOMASS ASHING FURNACES

The ashing process determines the amount of ash-forming material present in a petroleum product to enable a decision on its use in certain applications. Ash-forming materials are considered to be undesirable impurities or contaminants.

The ash remaining after coal or coke has been incinerated in air is derived from inorganic complexes present in the original coal substance and from associated mineral matter. The amount of sulphur retained in the ash is in part dependent on the conditions of ashing and, in order to obtain values for the ash on a comparable basis, it is necessary to adhere strictly to the conditions specified in the standards. BS ISO 1171:2024 specifies a method for the determination of the ash of all solid mineral fuels and ASTM D3174-12 specifies the test method for ash in an analysis sample of coal and coke.

The process involves heating the test portion in air at a specified rate up to a temperature of 815 °C ±10 °C and maintaining it at this temperature until constant in mass. The ash percentage is calculated from the mass of the residue after incineration.

The range of Carbolite AAF ashing furnaces complies with the standards above and are specifically designed to provide optimum ashing conditions to ensure complete combustion of the sample. The AAF 11/3 and AAF 11/7 have large floor areas which allow many samples to be accommodated. They are supplied with a corrosion and oxidisation resistant Inconel tray (maximum temperature 1100 °C) complete with loading handle. The low chamber height ensures the air flow is held close over the samples to promote burning. The traditional muffle heated chamber is extremely durable, giving good resistance to abrasion and to vapour attack.

The chamber provides heating on all four sides from wire elements which are wrapped around the outside of the chamber liner for protection. Good air flow is ensured by natural convection through a tall chimney and provides 4-5 volume air changes per minute. The incoming air is preheated before it enters the heated chamber ensuring that crucibles located near the inlet are not chilled.



AAF 11/3 and AAF 11/7 with optional AriesPlus controller

STANDARD FEATURES

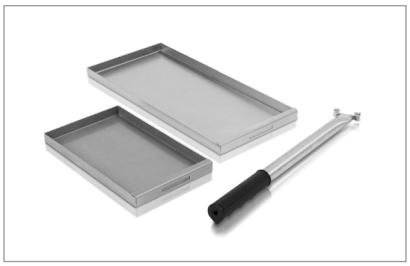
- 1100 °C maximum operating temperatures
- Carbolite 3016P1 single ramp to setpoint controller & process timer
- Large floor area allows for large number of samples
- Wire elements are protected from chemical & mechanical damage by a hard wearing alumina based liner
- Air inlet & tall chimney provide 4 to 5 volume air changes per minute
- Low chamber height holds airflow close to samples for optimum combustion
- Powerful elements with graded winding compensate for heat losses
- Preheating of air before it enters the chamber gives excellent uniformity
- Corrosion and oxidisation resistant Inconel sample tray and loading handle

OPTIONS (SPECIFY THESE AT TIME OF ORDER)

- 2 phase electrical supply for AAF 11/7
- Over-temperature protection (recommended to protect valuable contents & for unattended operation)
- Control Options
  - 3016P1 Programmable Controllers
  - AriesPlus Programmable Controllers
- Crucibles
- Crucible lid - required during cooling (ASTM D3174)



Optional crucibles and lids



Corrosion and oxidisation resistant Inconel sample trays and handle supplied as standard



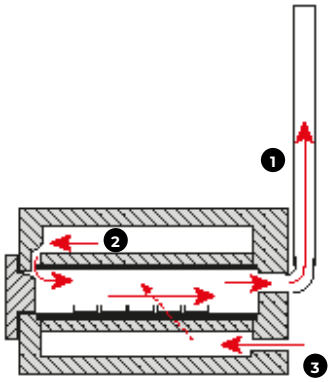
Standard corrosion and oxidisation resistant Inconel tray with optional crucibles

OPTIONS PART NUMBERS

Option	Item number
Fused silica crucible	40-209-460-0050
Aluminium crucible lid (as required in ASTM D3174-12)	40-209-100-0010
Crucible kit (crucible & lid)	AAF-CRUC-KIT
AAF 11/3 tray, dimensions inside W = 133 mm, D = 210 mm	00167-3-2051
AAF 11/7 tray, dimensions inside W = 163 mm, D = 330 mm	00167-3-2054
Additional tray loading handle	00125-3-1007

Airflow in AAF 11/3 and AAF 11/7:

1) A tall chimney pulls the air through the chamber - 35 mm diameter on AAF 11/3 and 50 mm diameter on AAF 11/7
2) Preheated air enters the chamber after circulating around the outside of the chamber
3) Air inlet





TECHNICAL DATA

Model	Max. temp. [°C]	Heat-up time [mins]	Max. continuous operating temp. [°C]	Dimensions: Internal H x W x D [mm]	Dimensions: External H x W x D [mm]	Dimensions: External with door open H x W x D [mm]	Dimensions: Height to top chimney [mm]	Volume [litres]	Max. power [W]	Holding power [W]	Thermocouple type	Weight [kg]
AAF 11/3	1100	155	1000	90 x 150 x 250	585 x 375 x 485	800 x 375 x 485	780	3	2100	1270	K	22
AAF 11/7	1100	155	1000	90 x 170 x 455	650 x 430 x 740	905 x 430 x 740	1060	7	4000	2624	K	63

Please note:
- Holding power is measured at 500 °C
- Heat up time is measured to 100 °C below max, using an empty chamber
- Maximum power and heat up time based on a 240 V supply

SNF – SWELLING NUMBER INDEX FURNACE

A swelling number is defined by reference to a series of standard profiles, the size and shape of the residue obtained when a specified mass of coal is heated in a covered crucible under specified conditions.

The Carbolite swelling number index furnace is designed to test the swelling index number of coal in accordance with the following Standards:

Standard	Description
BS ISO 501:2025	Hard Coal – Determination of the crucible swelling number.
ASTM D720-15	Standard Test Method for Free-Swelling Index of Coal.

The small scale free swelling index test is used to evaluate to what extent a coal will swell during coking, thereby helping to assess whether the coal is suitable for the production of coke and the amount necessary to fill the production plant. This involves heating a small sample of coal in a covered crucible to 800 °C.

The shape of the coke button obtained is classified by comparison with the outlines of a set of standard profiles. The results may be used as an indication of the caking characteristic of the coal when burned as a fuel.

STANDARD FEATURES

- Maximum operating temperature 900 °C
- 132 controller fitted as standard
- Top loading 55 mm diameter design x 85 mm deep with hinged lid
- 30 mA (RCD) residual current device, for additional protection
- Crucible, lid and holder
- Calibration kit



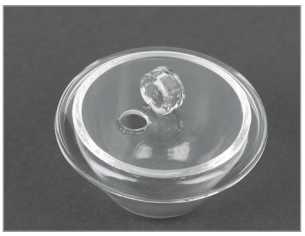
SNF with Calibration Kit



SNF

OPTIONS (SPECIFY THESE AT TIME OF ORDER)

- A range of temperature controllers
- Over-temperature protection (recommended)
- Crucible lid with hole (for calibration)



Silica crucible & lid with hole (optional) used for calibration



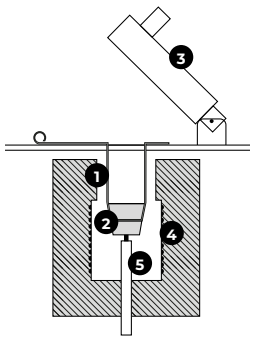
Wire crucible holder (standard) with crucible and lid (optional)

OPTIONS PART NUMBERS

Option	Item number
Crucible lid with diameter 6 mm hole (used for calibration)	40-209-460-0035
Additional crucible holder	00057-3-2006
Additional crucible kit (crucible & lid - without hole)	SNF-CRUCIBLE-K

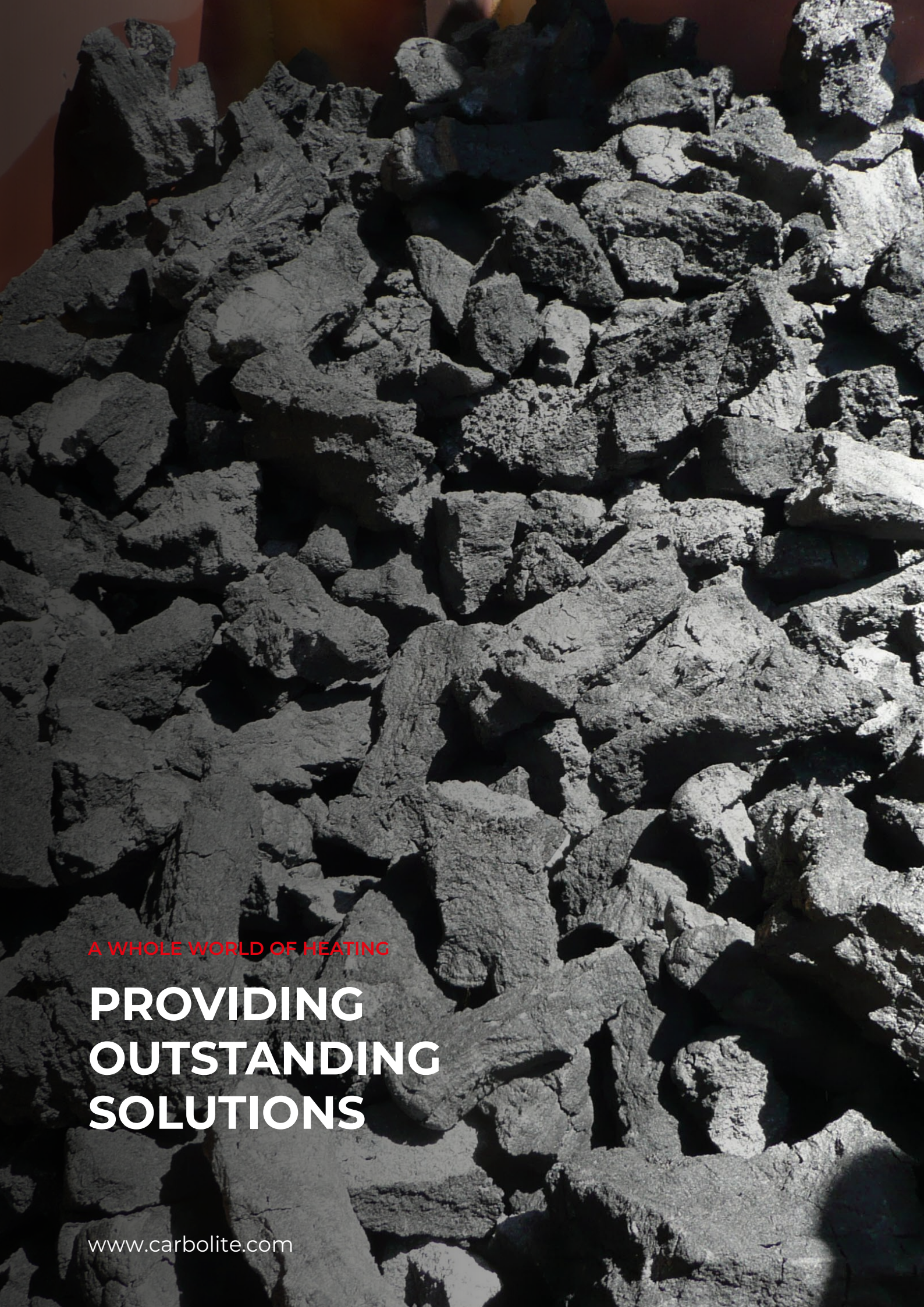
SNF cross section

1) Crucible holder
2) Crucible
3) Hinged lid
4) Heating elements
5) Control thermocouple



TECHNICAL DATA

Model	Max. temp. [°C]	Max. continuous operating temp. [°C]	External dimensions H x W x D [mm]	Crucible dimensions H x W x Ø at base [mm]	Crucible volume [ml]	Thermocouple type	Max. power [W]
SNF	900	850	330 x 410 x 300	26 x 41 x 11	17	K	900



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ARIESPLUS

THE NEW TEMPERATURE CONTROLLER

INTUITIVE NAVIGATION AND MORE

The AriesPlus touch screen controllers offer programmable control in which 99 segments may be set as ramp, step or dwell and may also be configured to control relays.

The ARIES series provides a capacitive touch screen interface giving intuitive access to a comprehensive menu for selection and editing of program profiles; scheduling of programs at a defined day and time; data logging of setpoint and actual temperature; localization of language; user level security. The ARIES series can also store and retrieve 50 unique program profiles.

Data-logging is to internal memory which can be downloaded to the adjacent USB port or downloaded to a PC if connected on a network. Ethernet connectivity is fitted as a standard feature.

When specified with a 3-zone product the control method is user selectable to be either retransmission of setpoint or independent control. With retransmission of setpoint the main zone controller's setpoint is automatically applied to the other zones. When running a program all zones will follow the program profile. With independent control each zones setpoint is set manually.

STANDARD FEATURES

- 7.0'' colour capacitive touch screen
- Setpoint & program profile control
- Data logging to internal memory
- 7-day time scheduler
- Ethernet connectivity
- Remote connection via a browser
- Panel mounted USB socket
- User level security
- Settings including 9 languages



The new AAF 11/7 with new AriesPlus touch screen controller

OPTIONAL FEATURES

The range of high quality PID (Proportional, Integral, Derivative) temperature controllers are fitted to Carbolite products. These controllers provide accurate temperature control that closely follows programmed ramp rates and setpoint temperatures.

OVER-TEMPERATURE CONTROL

- Integrated independent over-temperature protection with clear alarm indication; recommended for unattended operation and valuable load protection.

ALARM ACTIVATION

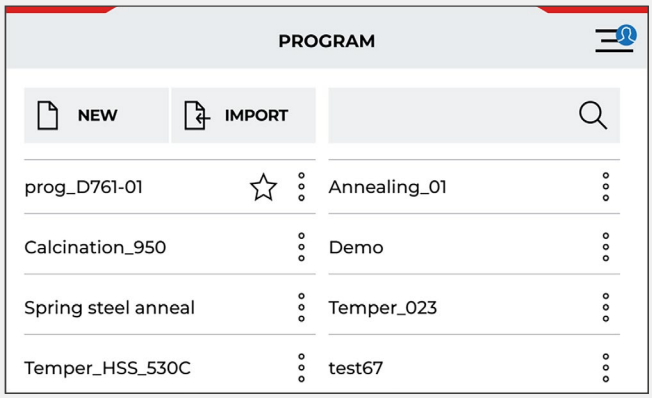
- Alarm options enable door locking and process accuracy monitoring.

PROGRAM SEGMENT EVENTS

- Program segment events activate options like switching gas flows or starting a cooling fan.

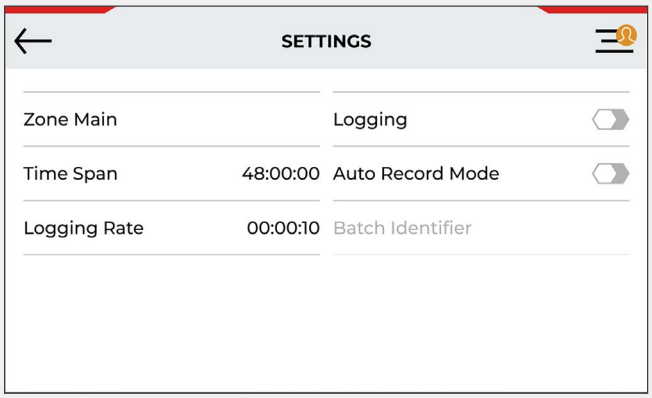
ARIESPLUS

EVERYTHING UNDER CONTROL



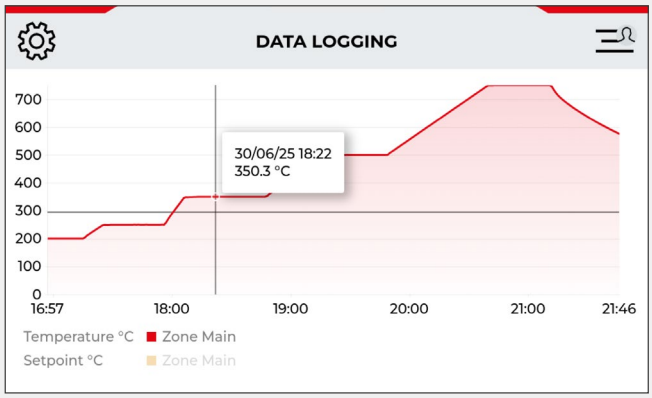
PROGRAMMING

- Manage up to 50 programs with USB/PC import/export; features include duplicate, rename, favorite, and delete.



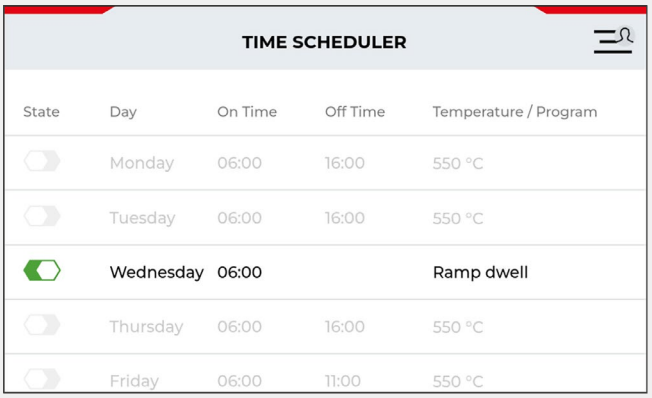
DATA LOGGING

- Set logging rate from 10 seconds; features batch ID and auto-logging on program start.



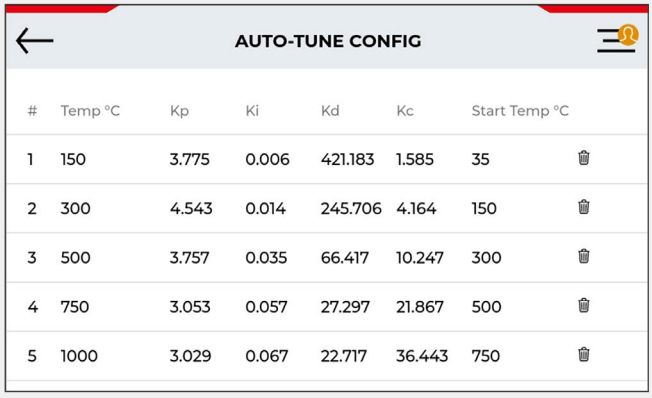
DATA LOGGING

- View live process graphs for up to 48 hours with pinch zoom; download by batch or date/time range.



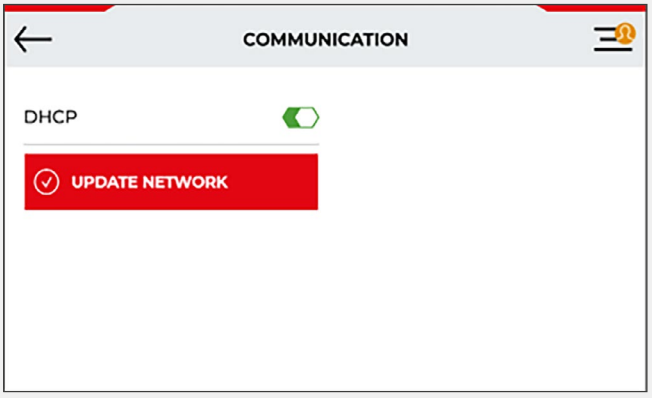
7 DAY TIME SCHEDULER

- Schedule daily heating or program runs at specified times.



AUTOTUNE

- Optimize for accurate operation across all temperatures; retune for specific processes.



REMOTE NETWORK CONNECTIVITY

- Ethernet-ready with DHCP or manual connection options.

CRI – COKE REACTIVITY FURNACE

Knowing the physical properties of coke is important as they predict the behaviour of coke in a blast furnace. The two tests frequently run to predict this are Coke Reactivity Index (CRI) to the Standard listed below and Coke Strength after Reaction (CSR) – see page 20

The Carbolite Coke Reactivity Index furnace (CRI) determines lump-coke reactivity in carbon dioxide gas at elevated temperatures. When coke lumps descend in the blast furnace they are subjected to reaction with counter current CO2 and to abrasion as they rub together and against the walls of the furnace. These concurrent processes physically weaken and chemically react with the coke lumps producing an excess of fines that can decrease burden permeability and result in increased coke rates and lost hot metal production. The test method is designed to indirectly measure the behaviour of coke in the blast furnace.

A dry coke sample of designated size and origin is reacted with CO2 gas in a retort at a specified elevated temperature for a specified length of time. The weight retained after reduction determines the CRI. The Carbolite Coke Reactivity Index furnace (CRI) has a maximum operating temperature of 1100 °C with three heating zones with an overall heated length of 700 mm. The modular heating system incorporates low thermal mass insulation and resistance coiled wire elements.



Coke Reactivity Furnace

Standard	Description
ASTM D5341/D5341M-17	Method for Measuring Coke Reactivity Index (CRI)
BS ISO 18894:2018	Coke -- Determination of Coke Reactivity Index (CRI)

STANDARD FEATURES

- Maximum operating temperature 1100 °C
- Eurotherm 2704 controller configured to meet either ASTM D 5341-17 or ISO 18894 (2018)
- Over-temperature protection
- Three heated zones with overall heated length of 700 mm
- Resistance wire heating elements
- Dual wall corrosion and oxidisation resistant Inconel sample retort which allows incoming gas to be preheated
- Gas safety system
- Audible safety alarms for over-temperature, low gas flow and flame failure on the gas safety system

TECHNICAL DATA

CGH Model	Max. temp. [°C]	Heated zones	Heated length [mm]	Dimensions: External H x W x D [mm]	Control system	Thermocouple type	Max. power [W]
CRI ASTM or ISO	1100	3	700	1800 x 1625 x 1100	Eurotherm 2704	N	10000

CONTROL SYSTEM

Eurotherm 2704 controller. The instrument software is configured for either the ASTM D5341/ D5341M-17 or ISO 18894:2018 tests. The instrumentation and associated power control equipment is housed within the integral control cabinet.

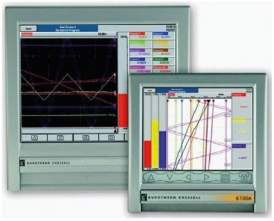


CASCADE CONTROL

Cascade control is used to correct the offset between the heating elements and load and uses an additional load loop with a type 'N' thermocouple. The load loop communicates with the element loop, calling for heat according to the load temperature and current program or set-point. The element loop regulates the heat according to element temperature and the requests from the load loop.

DATA LOGGING

A Eurotherm graphic display data logger is supplied to record process parameters. The channels are factory configured to record the three zone furnace temperatures and sample temperature.



PROCESS CONTROL

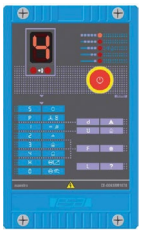
The test profile is controlled by the main temperature controller. Both temperature and gas flow are operated by the controller.

PROCESS GAS

Pipe fittings are provided to connect nitrogen and carbon dioxide which are required at pressures between 1.0 and 2.0 bar. Propane or natural gas is required for a pilot safety burner. The gases are mixed in the gas control cabinet and are fed into the retort by a single gas inlet.

GAS SAFETY SYSTEM

The furnace has an ionisation type flame detector which senses a flame failure and sounds an alarm. Should the flame not automatically re-establish itself within 30 seconds, process gas flow is shut down and a nitrogen purge is activated.



ALARM CONDITIONS

Audible alarms are provided for over-temperature, low gas flow and flame failure on the gas burn-off. Potentially dangerous alarm conditions abort the process and ensures the insert is safe.

OVER-TEMPERATURE PROTECTION

An independent thermocouple and temperature controller monitor the furnace temperature. Should an over-temperature condition occur power to the heating elements is switched off.



SAMPLE RETORT

A dual wall reaction retort is constructed from corrosion and oxidisation resistant Inconel allowing incoming gas to be pre-heated with provision made for the required probe thermocouple within the retort.

CSR – COKE STRENGTH AFTER REDUCTION – I-TESTER/TUMBLER CSR

The Coke Strength after Reduction (CSR) test measures the resistance of coke to degrade from impact and abrasion during its descent into the blast furnace. The coke is tumbled in a drum 600 times for 30 minutes. Most blast furnace operators require a coke with a CSR greater than 60.

A single tumbler unit is supplied to enable tumble testing in accordance with ASTM D5341-17 or ISO 18894 (2018). The tumbler is a free standing unit and consists of one drum. To allow worldwide use a variable frequency motor control is fitted, ensuring the tumbler stops after the required number of revolutions defined by the Standard.

The mesh guard has a safety interlock which stops the rotation when opened.



CSR I-Tester/Tumbler

Standard	Description
ASTM D5341/D5341M-17	Method for Measuring Coke Strength after Reaction (CSR)
ISO 18894:2018	Coke -- Determination of Coke Strength after Reaction (CSR)

STANDARD FEATURES

- Electric motor and gear box
- Variable frequency motor and gear box
- Pre-set counter to ensure exact number of revolutions required
- Safety cage
- Door safety switch
- Emergency stop button



CSI-CSR

TECHNICAL DATA

CGH Model	Rotation speed [rpm]	Dimensions: Internal Ø x W [mm]	Dimensions: External H x W x D [mm]
CSR	20	129 x 712	1235 x 1040 x 460

CTO 7 – FIXED WALL COKE TEST OVEN

Carbolite's pilot-scale fixed wall coking oven is designed for the testing of granulated and graded coals for coking under accurately controlled conditions.

In the production of coke for the metallurgical industries it is important to know how mixes of coal will behave in a commercial coking oven. This evaluation can be carried out quickly and economically in the laboratory by using the Carbolite standard 7 kg capacity coking oven. The charge is based on coal crushed to 85% <3 mm.

The Carbolite coking oven has been produced to enable qualitative data to be obtained on the conversion of coal to coke using laboratory scale samples.



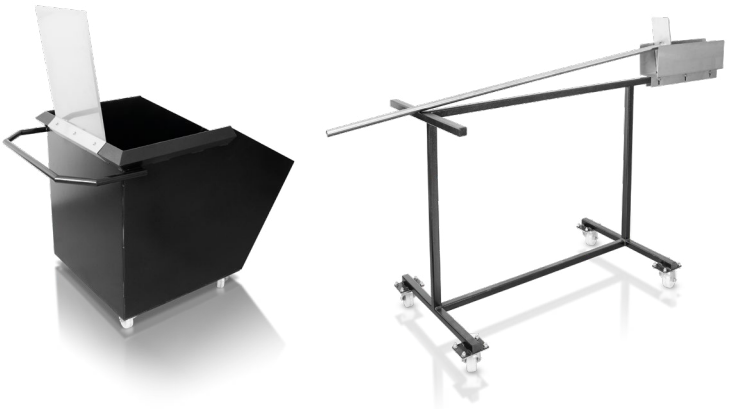
Fixed Wall Coke Test Oven

STANDARD FEATURES

- Maximum operating temperature 1300 °C
- 3504P1 standard controller with two 3216 slave controls
- Three vertical element zones heated by silicon carbide elements
- Outer door fitted with thermocouple ports allowing insertion of lance thermocouple probes.
- Over-temperature protection
- Paperless graphic recorder

OPTIONS (SPECIFY THESE AT TIME OF ORDER)

- An optional afterburner is available which has a maximum operating temperature of 1320 °C with a chamber capacity of 18 litres.
- CTO 23 (50 lbs) available on request
- CTO 115 (253 lbs) available on request
- CTO 227 (500 lbs) available on request
- Loading assembly
- Collection trolley



Collection trolley and loading assembly

TECHNICAL DATA

Model	Max. temp. [°C]	Dimensions: Internal H x W x L L = length between doors [mm]	Dimensions: External H x W x D [mm]	Controller	Control & power cabinet Dimensions: External H x W x D [mm]	Charge weight [kg]	Max. power [W]
CTO 7	1300	305 x 115 x 370	1750 x 800 x 700	3504P1	1600 x 800 x 600	7	16000

IOR – IRON ORE REDUCIBILITY FURNACE

The Carbolite IOR furnace meets the Standards listed below. It provides a relative measure with which oxygen, combined with iron, can be removed from natural or processed iron ores by a reducing gas, when reduced under conditions resembling those prevailing in the reduction zone of the blast furnace.

The test consists of isothermal reduction of a test portion at a specified size range. The test piece is located in a fixed bed within a reducing atmosphere, at a temperature dependent on the standard being used.

The furnace can be used for testing to either one, or combining up to three, of the following International Standards:

Standard	Description
BS ISO 4695-2021	Iron ores for blast furnace feedstocks - Determination of the reducibility by the rate of reduction index. This standard specifies a method to provide a relative measure for evaluating the extent to and ease with which oxygen can be removed from iron ores, when reduced under conditions resembling those prevailing in the reduction zone of a blast furnace. This standard is applicable to lump ores, sinters and hot-bonded pellets.
BS ISO 4696-1:2015	Iron ores for blast furnace feedstocks - Determination of low-temperature reduction-disintegration indices by static method. Reduction with CO, CO_2, H_2 and N_2.
BS ISO 4696-2:2015	Iron ores for blast furnace feedstocks - Determination of low-temperature reduction - disintegration indices by static method - Part 2: Reduction with CO and N_2. A relative measure for evaluating the degree of size degradation of iron ores when reduced with carbon monoxide and nitrogen, under conditions resembling those prevailing in the low-temperature reduction zone of a blast furnace. This part of ISO 4696 is applicable to lump ores, sinters and hot-bonded pellets.
BS ISO 4698:2007	Iron ore pellets for blast furnace feedstocks - Determination of the free-swelling index. A relative measure for evaluating the increase in the volume of iron ore pellets when reduced in an unconstrained bed under conditions resembling those prevailing in the reduction zone of a blast furnace. It specifies the determination of the free-swelling index. This Standard is applicable to hot-bonded pellets.
BS ISO 7215:2015	Iron ores for blast furnace feedstocks - Determination of the reducibility by the final degree of reduction index. A relative measure for evaluating the extent to which oxygen can be removed from iron ores when reduced under conditions resembling those prevailing in the reduction zone of the blast furnace. This Standard is applicable to lump ore, sinters and hot-bonded pellets.
BS ISO 7992:2015	Iron ores for blast furnace feedstocks - Determination of reduction under load. A relative measure for evaluating the structural stability of iron ores when reduced under conditions resembling those prevailing in the reduction zone of a blast furnace.



Iron Ore Reducibility Furnace with 3-zone vertical chamber and side integral control box

With a maximum operating temperature of 1100 °C the furnace provides a temperature stability better than ±1 °C under steady state conditions. The three zone vertical chamber has a heated length of 700 mm. The temperature controllers, associated power control equipment and gas control equipment are housed within the integral control box at the side of the furnace.

STANDARD FEATURES

- Maximum operating temperature 1100 °C
- Eurotherm 2704 control system with Eurotherm graphic display data logger
- Overall heated length 700 mm
- Three zone vertical chamber
- Over-temperature protection & gas safety system
- Mettler Toledo balance to determine the loss in mass of the reduced sample
- Corrosion and oxidisation resistant Inconel retort is provided for each test specification (up to a maximum of 3)

CONTROL SYSTEM

Eurotherm 2704 controller. The instrument software is pre-configured for the relevant ISO test. Input and output boards enable the process gases to be switched on and off as required. The instrumentation and associated power control equipment are housed within the integral control cabinet.

CASCADE CONTROL

Cascade control is used to correct the offset between the heating elements and load and uses an additional load loop with a type 'N' thermocouple. The load loop communicates with the element loop, calling for heat according to the load temperature and current program or set-point. The element loop regulates the heat according to element temperature and the requests from the load loop.

DATA LOGGING

A Eurotherm graphic display data logger is supplied to record process parameters. The channels are factory configured to record the three zone furnace temperatures, sample temperature and also the weight.

PROCESS GAS

The test profile is controlled by the main temperature controller; both temperature and gas flows are operated by the controller. Due to the function of instrumentation, the equipment is considered to be semi-automatic; the operator is required to load and unload the furnace.

Pipe fittings are provided for the relevant gases. Propane or natural gas is required for a pilot safety burner. The gases are mixed in the gas control cabinet and are fed into the retort by a single gas inlet.

GAS SAFETY SYSTEM

The furnace has an ionisation type flame detector which senses a flame failure and sounds an alarm. Should the flame not automatically re-establish itself within 30 seconds, the process gas flow is shut down and a nitrogen purge is activated.

ALARM CONDITIONS

Audible alarms are provided for over-temperature, low gas flow and flame failure on the gas burn-off. Potentially dangerous alarm conditions abort the process and ensures the equipment is safe.

OVER-TEMPERATURE PROTECTION

An independent thermocouple and temperature controller monitor the furnace temperature. Should an over-temperature condition occur power to the heating elements is switched off.

CORROSION AND OXIDISATION RESISTANT INCONEL RETORT

A retort is provided for each test specification. Each retort is manufactured from 2 mm thick corrosion and oxidisation resistant Inconel and has a double wall construction. The retorts have gas inlet and outlet connections and the lids are bolted into position. Provision is made for probe thermocouples within the retort.

MEASUREMENT OF WEIGHT LOSS

A balance is supplied in order to determine the loss in mass of the reduced sample. The balance, with a resolution of 0.1 g, is connected to the retort during the entire process cycle.

TECHNICAL DATA

CGH Model / Combinations of Standards	Max. temp. [°C]	No. of control zones	Dimensions: External H x W x D [mm]	Temperature control system	Heated length [mm]	Thermo-couple type	Max. power [W]
Iron Ore combined test unit	1100	3	1800 x 1625 x 1100	Eurotherm 2704	700	N	10000
ISO 4695 & BS ISO 4696-1:2015	1100	3	1800 x 1625 x 1100	Eurotherm 2704	700	N	10000
ISO 4695 & BS ISO 4696-2:2015	1100	3	1800 x 1625 x 1100	Eurotherm 2704	700	N	10000
BS ISO 4696-2:2015 & BS ISO 4698:2007 & BS ISO 7992:2015	1100	3	1800 x 1625 x 1100	Eurotherm 2704	700	N	10000
BS ISO 7215:2015	1100	3	1800 x 1625 x 1100	Eurotherm 2704	700	N	10000
BS ISO 4696-2:2015 & BS ISO 7215:2015 & BS ISO 7992:2015	1100	3	1800 x 1625 x 1100	Eurotherm 2704	700	N	10000

IOT – IRON ORE TUMBLER

The Carbolite iron ore tumbler meets Standard BS ISO 4696–1:2015 'Iron ores for blast furnace feedstocks — Determination of low-temperature reduction-disintegration indices by static method — Part 1. It is applicable to lump ores, sinters and hot-bonded pellets.

This test method provides a relative measure for evaluating the degree of size degradation of iron ores when reduced with carbon monoxide, carbon dioxide, hydrogen and nitrogen under conditions resembling those prevailing in the low-temperature reduction zone of a blast furnace.

The reduced test portion is tumbled in a single tumble drum for 30 revolutions per minute. This easy to operate free standing tumbler is manufactured from 1.6 mm mild steel plate connected to a single shaft which is rotated by an electric motor. To allow worldwide use a variable frequency motor control is fitted, ensuring the tumbler stops after the required number of revolutions defined by the Standard.

The mesh guard has a safety interlock which stops the rotation when opened.

STANDARD FEATURES

- Electric motor and gear box
- Variable frequency motor and gear box
- Pre-set counter to ensure exact number of revolutions required
- Safety cage
- Door safety switch
- Emergency stop button



Iron Ore tumbler

TECHNICAL DATA

CGH Model	Rotation speed [rpm]	Dimensions: Internal Ø x W [mm]	Dimensions: External H x W x D [mm]
Iron ore tumbler	30	130 x 200	935 x 360 x 525

GLO 40/11-1G – COAL CHARACTERISATION

The characterisation of coal requires various tests, including heating it in a nitrogen atmosphere up to 1000 °C where pyrolysis occurs. During this process, the coal loses a degree of weight which is a good measure of its quality. The Carbolite GLO 40/11-1G is used for this process to analyse how the coal reacts and to determine its behaviour.

For this specific process the furnace is modified for pyrolysis and the gas outlet is not equipped with any valves, therefore there is no pump. Inertisation is achieved by purging with nitrogen or argon prior to heating and to ensure maximum safety this is done in a vessel. The gas outlet is equipped with a heated gas outlet and an afterburner.

The sample is placed on a horizontal charging rack and the incoming gases are guided uniformly over the sample by a gas circulation system. Any gaseous by-products are immediately flushed out of the furnace.

The GLO 40/11-1G offers excellent temperature uniformity. A probe thermocouple is positioned at the rear of the furnace in close proximity to the sample, which serves as the control thermocouple for the two heating zones monitoring the temperature at the sample.



GLO 40/11

STANDARD FEATURES

- 1100 °C maximum operating temperature
- Excellent temperature uniformity
- 40 litre capacity
- Precisely controlled atmosphere with optimum purity
- Temperature resistant steel alloy retort
- Afterburner
- Certified safety system for flammable and toxic gases
- Choice of fully automatic or manual operation
- Data recording for quality management
- Compact, space saving design

OPTIONS (SPECIFY THESE AT TIME OF ORDER)

- Choice of software and controller options
- Fast heat up and cool down options
- Thermocouple probes in retort
- Chiller, should no water cooling be available on-site

TECHNICAL DATA

CGN Model	Max. operating temperature [°C]	Dimensions: External H x W x D [mm]	Volume [l]	Max. Power [W]
GLO 40/11-1G	1100	1900 x 1400 x 1800	40	25000

LTD – LOW TEMPERATURE REDUCTION – DISINTEGRATION OF IRON ORE

The Carbolite furnace for dynamic testing for low temperature reduction – disintegration of Iron Ore meets the International Standard BS ISO 13930:2015 'Iron ores for blast furnace feedstocks — Determination of low-temperature reduction-disintegration indices by dynamic method' specifications. This Standard test method can be used to provide results as part of a production quality control system, as a basis of a contract, or as part of a research project.

The test provides a relative measure for evaluating the degree of size degradation of iron ores when reduced under conditions resembling those prevailing in the low-temperature reduction zone of the blast furnace.

Iron ore pellets, which have been thoroughly dried, are placed in a rotating tube and subject to "tumbling during reduction". The test portion is isothermally reduced in a rotating tube at 500 °C using a reducing gas consisting of CO, CO2, H2 and N2 for 60 minutes.

The corrosion and oxidisation resistant Inconel retort is a rotating reduction barrel containing 4 lifter bars which rotates about its axis within the furnace. Agitation of the sample ensures all surfaces are subjected to the reducing atmosphere.

Provision is made for the required probe thermocouple within the retort. The samples are then subjected to a sieve analysis to determine the degree of disintegration.

The reduction barrel is driven from a variable speed electric motor. The front section of the furnace is mounted on a counter balanced parallel link mechanism which allows easy access for loading and unloading the reduction barrel. A dust collector is placed at the end of the gas outlet to collect dust exiting the rotating tube.

STANDARD FEATURES

- Maximum operating temperature 1000 °C (without reduction barrel)
- Eurotherm 2704 controller with cascade control and graphic display data logger
- Easy access for loading and unloading the reduction barrel
- Gas safety system
- Audible alarm system for over-temperature, low gas flow and flame failure on the gas burn off
- Corrosion and oxidisation resistant Inconel retort



Low Temperature Reduction - Disintegration of Iron Ore Furnace

CONTROL SYSTEM

A Eurotherm 2704 controller. The instrument software is pre-configured for the relevant ISO test. Input and output boards enable the process gases to be switched on and off as required. The instrumentation and associated power control equipment are housed within the integral control cabinet.

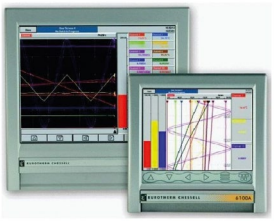


CASCADE CONTROL

Cascade control is used to correct the offset between the heating elements and load and uses an additional load loop with a type 'N' thermocouple. The load loop communicates with the element loop, calling for heat according to the load temperature and current program or set-point. The element loop regulates the heat according to element temperature and the requests from the load loop.

DATA LOGGING

A Eurotherm graphic display data logger is supplied to record process parameters. The channels are factory configured to record the three zone furnace temperatures, sample temperature and also the weight.



PROCESS GAS

Nitrogen, carbon monoxide, carbon dioxide and hydrogen are required and pipe fittings are provided for customer connection. Propane or natural gas is required for a pilot safety burner. With the exception of the propane line, the gas supplies are divided and pass through a series of needle valves and flowmeters, allowing flow control of process gas. The gases combine providing a single gas inlet into the retort.

GAS SAFETY SYSTEM

The furnace has an ionisation type flame detector which senses a flame failure and sounds an alarm. Should the flame not automatically re-establish itself within 30 seconds, process gas flow is shut down and a nitrogen purge is activated.

ALARM CONDITIONS

Audible alarms are provided for over-temperature, low gas flow and flame failure on the gas burn-off. Potentially dangerous alarm conditions abort the process and ensures the equipment is safe.

OVER-TEMPERATURE PROTECTION

An independent thermocouple and temperature controller monitor the furnace temperature. Should an over-temperature condition occur power to the heating elements will be switched off.



TECHNICAL DATA

CGH Model	Max. temp. [°C]	Heating zones	Heated length [mm]	Dimensions: External H x W x D [mm]	Inconel retort Ø x length [mm]	Thermocouple type	Control system	Max. power [W]
Dynamic testing for low temperature reduction	1000 / 800 (without / with reduction barrel)	3	715	1500 x 1800 x 1060	150 x 540	N	Eurotherm 2704 Cascade	12000

COAL AND COKE PRODUCTS – STANDARDS SUMMARY

	MODELS								
	MFS/1	VMF	AAF	SNF	CRI	CSR	IOR	IOT	LTD
Pages	6	8–9	10–11	12	18–19	20	26–27	28	30–31
ASTM									
ASTM D3173-25	●	–	–	–	–	–	–	–	–
ASTM D3174-12(2018)e1	–	–	●	–	–	–	–	–	–
ASTM D3175-20	–	●	–	–	–	–	–	–	–
ASTM D5341/D5341M-17	–	–	–	–	●	●	–	–	–
ASTM D720-15	–	–	–	●	–	–	–	–	–
BS ISO									
BS ISO 1171:2024	–	–	●	–	–	–	–	–	–
BS ISO 11722:2013	●	–	–	–	–	–	–	–	–
BS ISO 13930:2015	–	–	–	–	–	–	–	–	●
BS ISO 18894:2018	–	–	–	–	●	●			–
BS ISO 4695:2021	–	–	–	–	–	–	●		–
BS ISO 4696-1:2015	–	–	–	–	–	–	●	●	–
BS ISO 4696-2:2015	–	–	–	–	–	–	●		–
BS ISO 4698:2007	–	–	–	–	–	–	●		–
BS ISO 501:2025	–	–	–	●	–	–	–	–	–
BS ISO 562:2024	–	●	–	–	–	–	–	–	–
BS ISO 687:2024	●	–	–	–	–	–	–	–	–
BS ISO 7215:2015	–	–	–	–	–	–	●	–	–
BS ISO 7992:2015	–	–	–	–	–	–	●	–	–

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Model	Description	up to	Page
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AAF	Coal Ashing Furnaces	1100 °C	10 – 11
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CRI	Coke Reactivity Furnace	1100 °C	16 – 17
CSR	Coke Strength after Reduction Tumbler	-	18
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G			
GLO	Coal Characterisation Pyrolysis Furnace	1100 °C	23
I			
IOR	Iron Ore Reducibility Furnace	1100 °C	20 – 21

Model	Description	up to	Page
IOT	Iron Ore Tumbler	-	22
L			
LTD	Low Temperature Reduction – Disintegration of Iron Ore (ISO 13930: 2015)	1000 °C	24 – 25
M			
MFS/1	Minimum Free Space Oven	210 °C	6
S			
SNF	Swelling Number Index Furnace	900 °C	12
V			
VMF	Volatile Matter Furnace	1000 °C	8 – 9

OPTIONAL PART SPECIFICATIONS AND ITEM NUMBERS

Part Number	Product	Description	Height [mm]	Width [mm]	Depth [mm]	Crucible			Lid	
						External Ø [mm]	Height [mm]	Wall thickness [mm]	External Ø [mm]	External height [mm]
40-209-460-0025	VMF 10/6	Crucible & lid	-	-	-	24.5-25.5	37.5-38.5	1	27-28	7-8
00037-3-2003	VMF 10/6	4 crucible stand (not including handle)	51	102	81	-	-	-	-	-
00037-3-2004	VMF 10/6	9 crucible stand (not including handle)	51	142	121	-	-	-	-	-
00125-3-1007	VMF 10/6	Crucible stand / tray loading handle	25	46	345	-	-	-	-	-
40-209-010-0020	VMF/ASTM	Inconel crucible & lid	-	-	-	27	34	0.7	26.5	11
00329-3-2001	VMF/ASTM	Wire crucible holder	118	120	78	-	-	-	-	-
40-209-460-0050	AAF MFS/1	Fused silica crucible	-	-	-	55	15	2.5	-	-
40-209-100-0010	AAF, MFS/1	Aluminium crucible lid (as requested in ASTM D3174-12)	-	-	-	-	-	-	54	3-4
00057-3-2006	SNF	Additional crucible holder	89	1.30	88	-	-	-	-	-
40-209-460-0035	SNF	Crucible lid with 06mm hole	-	-	-	-	-	-	46-48	14
SNF-CRUCIBLE-K	SNF	Additional crucible kit (crucible & lid – without hole)	-	-	-	40-42	25-27	2	46-48	14
00047-4-1532-SP	MFS/1	Additional tray for desiccator	21	190	235	-	-	-	-	-
00167-3-2051	AAF 11/3	Additional tray	16	136	223	-	-	-	-	-
00167-3-2054	AAF 11/7	Additional tray	16	166	343	-	-	-	-	-

HEATING APPLICATIONS

Carbolite offers a wide range of ovens and furnaces for over 70 applications across various industries. Our focus on innovation and quality ensures advanced thermal processing solutions tailored to client needs.

Key areas include Additive Manufacturing, Crystal Growth, Debinding & Sintering, Graphitization, Stress Relieving, Vacuum Soldering, and Brazing.

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